

# The Fox Project: Advanced Development of Systems Software

R&D Status Report  
July 31 to September 30, 1998

School of Computer Science  
Carnegie Mellon University  
Pittsburgh, PA 15213

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# Carnegie Mellon

## Computer Science Department

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October 15, 1998

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RE: Contract F19628-95-C-0050  
"The Fox Project: Advanced Languages for Systems Software"  
#1-52220

Hi Harry,

Enclosed is the quarterly R&D Status Report covering our research progress during the period July 31 through September 30, 1998. Please accept our apologies for this report being late.

Please contact me at 412/268-3853 if you have any questions.

Have a wonderful day!

Best regards,



Rosie Battenfelder

/rmb  
Enclosures

Copy to: G. Koob, DARPA/ITO  
C. Stephan, ESC/AXK  
DARPA Technical Library  
Office of Naval Research  
✓ Defense Technical Information Center/OCC

P. Lee, CMU  
R. Harper, CMU  
M. Brendel, CMU  
A. Stoltzfus, CMU

The long-term objectives of the Carnegie Mellon Fox Project are to improve the design and construction of systems software and to further the development of advanced programming language technology. We use principles and techniques from the mathematical foundations of programming languages, including semantics, type theory, and logic, to design and implement systems software, including operating systems, network protocols, and distributed systems. Much of the implementation work is conducted in the Standard ML (SML) language, a modern functional programming language that provides polymorphism, first-class functions, exception handling, garbage collection, a parameterized module system, static typing, and a formal semantics. This Project involves several faculty members and spans a wide range of research areas, from (1) advanced compiler development to (2) language design to (3) software system safety infrastructure.

## 1 Research Progress

We report on the research accomplishments during the third calendar quarter of 1998, and the research objectives for the fourth quarter of 1998.

### Accomplishments (July-Sept):

- Completed the design of a dependently typed implementation of ML. This will allow the compiler to more closely resemble the semantics of ML.
- Completed the design of extensions to TILT to include support for MLBox, which supports source-level run-time code generation constructs.
- Released the Twelf 1.2 proof development system. This system is capable of automatically proving soundness theorems.
- Released the Touchstone/PCC compiler for generating Proof-Carrying Code.
- Finished the Fox Net performance testing.
- Finished the Ph.D. dissertation entitled *Compiling with Proofs* and defended it successfully.

**Objectives (October-December):**

- Finish the extension of the TILT compiler to include support for MLBox, which supports source-level run-time code generation constructs as described in “Run-Time Code Generation and Modal-ML” (Wickline et al., 1998).
- Finish the first dependently typed implementation of ML.
- Design a compiler for native x86 code for the MLBox language.
- Complete the first public release of the TILT/ML compiler.
- Develop the algorithmic theory for the middle internal language of the TILT/ML compiler, prove its termination (at least up to termination of equivalence checking), and relate it to the declarative type-checking rules.
- Work on speeding up the type-checker implementation in the TILT compiler.
- Complete the final release of Fox Net.
- Finish and submit the Fox Net journal paper.

**2 Noteworthy Publications**

- *Automated Theorem Proving in a Simple Meta-Logic for (LF)* by Carsten Schuermann and Frank Pfenning. CADE-15, July, 1998.
- *Reasoning About Deductions in Linear Logic* by Frank Pfenning. CADE-15, July, 1998.

**3 Capital Equipment Purchases**

- 1 21” Hitachi Monitor, \$1,044.00
- 1 220-8756 6400 PII/MT Workstation 610  
Base w/Integrated 3Com Fast, \$4,145.00
- 1 HP 4000N Laserjet Printer, \$1,360.00
- 1 FX-E8 Flexscan FX-E8 21” Monitor, \$2,071.00

## **4 Key Personnel Changes**

- None

## **5 Noteworthy Meetings**

- DARPA/ITO Quorum/High Confidence Computing PI Meeting (San Diego, California, July 12-17, 1998).
- International Conference on Functional Programming (ICFP'98) (Baltimore, MD, September 26-29, 1998).

## **6 Administrative Data**

CMU Center: 1-52220

Subcontractors - Name:

Subcontractors - Funding to Date:

Subcontractors - Planned FY1999 Funding:

Base Funding (excludes options): 5,630,798

Funded Options:

UNFunded Options: 648,704

Total Funding Provided to Date (both base and options): 3,617,974

Total Funding Expended to Date (both base and options): 2,916,926

Total Funding UNExpended: 701,048

Date Current Funding will be Expended: 31 MAR 1999

Funding Expended in Most Recent Quarter: 242,338

Incremental Funding required for FY 1999: 800,000

Date of Financial Data: 30 SEP 1998